DEEP DRIFT SCANNING

A project to establish a Deep Underground Science and Engineering Lab (DUSEL) in the former Homestake gold mine in Lead, South Dakota, is benefiting from Maptek™ technology and expertise.

DUSEL will support the underground research needs of major scientific studies in particle and nuclear physics, geology, hydrology, geo-engineering, biology and biochemistry. The dedicated access and diverse geology at Homestake are well suited for studies at extreme depth.

Maptek was contracted to collect data in support of the preliminary design and planning of the laboratory. The drift was mined in 1920; no geological mapping was available for the detailed modelling necessary.

Maptek scanned the Kirk and Oro drifts at the 300 level to allow mapping of the geology. Narrow confines meant that Maptek I-Site Technical Services Manager Scott Schiele used the **Z+F IMAGER® 5006i** with the **Z+F M-Cam** camera attachment for very close range capture of data from drift and rock outcrops.

Field work over 2 days in April 2009 provided scanning and photographic data for the 1400 ft of interest. Scanning from 70 setups, with 28 photographs at each location, ensured adequate coverage of the underground structures.

Issues requiring resolution included access, backsighting and registration, appropriate lighting for photography, and managing the massive volume of data to produce useful results.

The Z+F scanner, with a fast acquisition rate and short minimum range, collected 8 million points in 1 min 4 sec, producing a 40 MB file on medium resolution. On high resolution 40 million points were collected in 3 min 20 sec for a 180 MB file.

It took about 5 minutes to automatically capture the 28 images post-scan, which were then accurately mapped onto the scan data.

When you add 70 scans and 1960 photographs to 70 control points, the result is 8 GB of data.

Lighting challenges were overcome by trial and error. Manually pointing a 24 volt source at the photographic area required the scanner motion to be followed closely. When the narrow confines meant that the scanner and light source were very close to the surface been photographed, new lighting options were developed.

Some lights gave a yellow tint, which affected interpretation of the true nature of the geology. An array of lights mounted on a wagon at a lower vantage point than the camera caused shadowing. Manoeuvring both wagon and scanner in the drift was not easy.

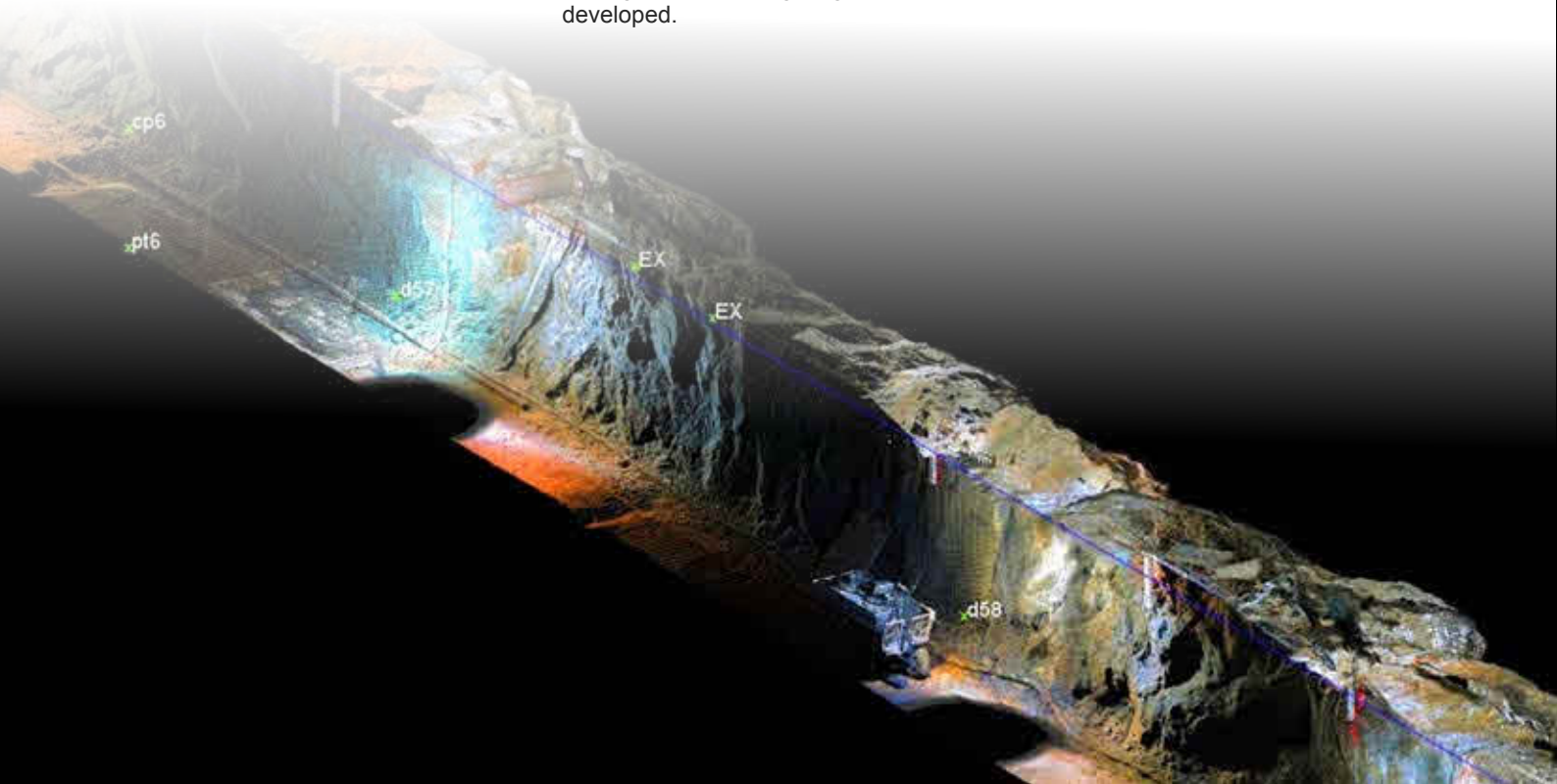
Now you've got all this data...

Scans and associated photographs were imported into I-Site Studio and registered into the coordinate system. Scans were cut into 100 ft sections and modelled, creating photo-rendered triangulations that could be used for mapping the geology.

The 28 photographs for each scan were used to map the colour data onto the scan, and one 360-degree photograph was produced for use when importing the data into I-Site Studio.

'IT IS ANTICIPATED THAT MAPTEK SERVICES MIGHT BE NEEDED THROUGHOUT THE PRELIMINARY AND FINAL DESIGN PHASES OF THE PROJECT, AS WELL AS DURING CONSTRUCTION.'

Dr Zbigniew J. Hladysz
South Dakota School of Mines



The first step in registration was to manually rotate scans around the origin of the scanner and apply global registration. Scans were then automatically rotated to a more accurate position using I-Site Studio's 'matching features' option, which picks common features in scans with overlapping data.

Once the data was in the correct coordinate system, unnecessary objects – scanner, pipes, wagon – and people could be filtered out. Scans of the drifts were cut in half down the centreline, making it easier to remove unwanted points from the middle of each section to better view the geology.

Modelling could then begin...

A minimum separation of 0.8 ft was applied to reduce 8 million points to 150,000. Triangulations were merged and fused with the 100-foot sections to create one continuous surface.

The photographs were then rendered onto this surface, matching the points from the scans to the imagery.

The model was then imported into Maptek Vulcan™ software. Vulcan brings together the 3D photo-rendered model, old geology maps, drillholes and other geological data into the one environment for advanced geotechnical analysis.

I-Site Studio is the most advanced software for processing, managing and modelling the point cloud data acquired from laser scanning.

While the 64-bit processing power of I-Site Studio proved equal to the task of handling the massive datasets from the DUSEL project, some enhancements were needed to ensure usable results.

One innovation is a new option to allow the viewing and manipulation of medium resolution scans; this provides a manageable file size, while retaining the high resolution data for detailed analysis of specific areas of interest. This streamlined the file load and zoom functions without losing any detail for in-depth geological analysis.

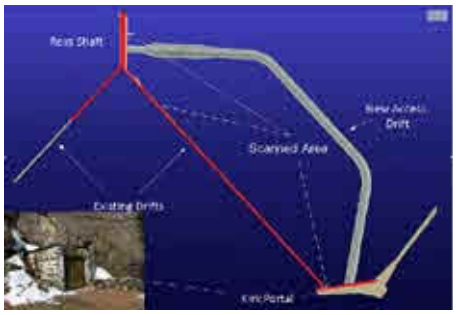
'LASER SCANNERS PROVIDE THE REQUIRED COVERAGE AND RESOLUTION FOR UNDERGROUND AND SURFACE SCANNING. MAPTEK PROVIDES THE BEST INTEGRATION OF THE SCANNED DATA WITH 3D CAD GEOTECHNICAL TOOLS.'

DUSEL BACKGROUND

The DUSEL project is funded by the National Science Foundation. Construction on the two deepest labs is planned to start by 2012.

Homestake is the deepest mine in North America with rooms at 8000 ft (2438 m). It is well-suited for experiments requiring extremely low cosmogenic backgrounds.

The Yates Formation has well characterised strong rock that can support deep, large cavities to host very large detectors for proton decay and neutrinos from different natural sources. Geoscientists and engineers will be able to research the behaviour of subsurface rock, minerals, water and energy sources.



LASER SCANNING SERVICES WHEN YOU NEED THEM
Maptek I-Site Services Manager, Scott Schiele manoeuvred the scanner and wagon in the confines of the Homestake drifts.

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